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मानक

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IS 14814 (2000): Acetylene - Code of Safety [CHD 8: Occupational Safety, Health and Chemical Hazards]



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“Knowledge is such a treasure which cannot be stolen”

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IS 14814 : 2000
(Reaffirmed-2012)

भारतीय मानक
एसीटिलीन — सुरक्षा संहिता

Indian Standard
ACETYLENE — CODE OF SAFETY

ICS 71.080;13.300

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BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

August 2000

Price Group 4

FOREWORD

This Indian Standard was adopted by the Bureau of Indian Standards, after the draft finalized by the Chemical Hazards Sectional Committee had been approved by the Chemical Division Council.

Acetylene is the simplest member of the class of unsaturated hydrocarbons called alkynes or acetylenes. It is one of the most important of all starting materials for organic synthesis, particularly in commercial operations. Because of its high chemical reactivity, acetylene is an extremely versatile chemical in industrial synthesis. Approximately 80 percent of total annual production in the world is used for chemical synthesis. Acetylene has come into increasing prominence as the raw material for a whole series of organic compounds among them vinyl chloride, neoprene, vinyl acetate, acrylonitrile, vinyl ethers, vinyl acetylene, trichloroethylene, and perchloroethylene. These compounds are used in turn to produce a diverse group of products including plastics, synthetic rubber, dyestuffs, solvents and pharmaceuticals. Acetylene is also utilized to manufacture carbon black.

The remaining 20 percent of the acetylene production is principally used for oxyacetylene cutting, welding and heat treating and as a fuel for atomic absorption instruments. Small amounts are used for lighting purpose in buoys, lighthouses, beacons and similar devices.

There is no ISO standard on the subject. In preparation of this standard considerable assistance has also been derived from the following publications:

- a) Matheson Gas Data Book by William Braker and Allen L. Mossman
- b) Hand Book of Compressed Gases, Compressed Gas Association, INC, Washington D.C.
- c) Acetylene — S.A. Miller — Vol. I

The composition of the technical committee responsible for formulation of the standard is given in Annex A.

**AMENDMENT NO. 1 AUGUST 2007
TO
IS 14814 : 2000 ACETYLENE — CODE OF SAFETY**

(Page 1, clause 4.2.3) — Substitute the following for the existing:

'Boiling point at 100 kPa (1 atm) : (-) 84°C (sublimation)'

(Page 1, clause 4.2.10) — Add the following new clause after **4.2.10**:

'4.2.11 Melting Point: (-)81.8°C'

(Page 2, clause 5.2.1, last sentence) — Substitute the following for the existing:

'OSHA Permissible Exposure Limit (PEL-CL) for ammonia is 2 500 ppm'

(CHD 8)

Indian Standard

ACETYLENE — CODE OF SAFETY

1 SCOPE

1.1 This standard describes properties of acetylene, the nature of hazards associated with it and essential information on storage, handling, packing, labelling, disposal of waste, spillage/leakages, training of personnel, personnel protective equipment and first-aid.

1.1.1 This standard, however, does not deal with the specifications for design of buildings, chemical engineering plants, storage vessels and equipment for operation controls.

2 REFERENCES

The Indian Standards listed below contain provisions which through reference in this text, constitute provisions of this Indian Standard. At the time of publication, the editions indicated were valid. All standards are subject to revisions, and parties to agreements based on this Indian Standard are encouraged to investigate the possibility of applying the most recent editions of the Indian Standards:

<i>IS No.</i>	<i>Title</i>
2148 : 1981	Flame proof enclosures for electrical apparatus (<i>second revision</i>)
4155 : 1966	Glossary of terms relating to chemical and radiation hazards and hazardous chemicals
4167 : 1981	Glossary of terms relating to air pollution (<i>first revision</i>)
4379 : 1981	Identification of the contents of industrial gas cylinder (<i>first revision</i>)
7062 : 1973	Glossary of terms used in gas industry

3 TERMINOLOGY

For the purpose of this standard, definitions given in IS 7062, IS 4155 and IS 4167 shall apply.

4 GENERAL PROPERTIES

4.1 General Information

Acetylene is a colourless flammable gas. It is slightly lighter than air. Acetylene burns with a dazzling light. It is highly flammable gas with dangerous risk of fire and explosion if not properly handled.

4.1.1 *Common Name* Acetylene.

4.1.2 Chemical Names

Acetylene, Ethyne, Ethine or Narcylene.

4.1.3 *Chemical Formula* C_2H_2

4.1.4 *Structural Formula* : $H-C \equiv C-H$

4.1.5 *Molecular Weight* : 26.04

4.1.6 *UN No.* : 1001

4.1.7 *CAS No.* : 74-86-2

4.2 Physical Properties

4.2.1 Description, Colour, Odour, Physical State

Pure acetylene is a colourless, odourless highly inflammable gas. Acetylene of ordinary commercial purity has a distinctive garlic like odour. Acetylene can be liquefied and solidified with relative ease. However, in both the liquid and solid states, acetylene explodes with extreme violence when ignited unless special conditions of confinement are employed.

4.2.2 Specific Gravity

a) gas (air = 1) at 15°C and 1 atm pressure — 0.906

b) liquid (water = 1) at (-)80°C — 0.613

4.2.3 Boiling Point at 100 kPa (1 atm) (-)84°C

4.2.4 Miscibility/Solubility

It is very soluble in acetone, one volume of which will dissolve 300 volumes of acetylene at 1 207 kPa. It is slightly soluble in water (at 15.6°C). It is also soluble in DMF.

4.2.5 *Triple Point* : (-)82°C at 122 kPa

4.2.6 *Critical Temperature* : 35.15°C

4.2.7 *Critical Pressure* : 6 059 kPa

4.2.8 *Latent Heat of Vaporization at Triple Point* : 614 kJ/kg

4.2.9 *Specific Heat of Gas at 1 atm and 15.6°C* : 1.60 kJ/kg

4.2.10 *Vapour Pressure at 20°C* : 4 406 kPa

4.3 Chemical Properties

4.3.1 Reactivity

Acetylene, because of its triple bond, reacts additively with a wide variety of reagents for example hydrogen, halogens, hydrogen halides, hydrogen cyanide,

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alcohols, carboxylic acids, aliphatic amines and arsenic trichloride, etc. Acetylene burns in air with an intensely hot, luminous and smoky flame. The ignition temperatures of acetylene and of acetylene air and acetylene oxygen mixtures vary according to composition, initial pressure, initial temperatures and water vapour content.

4.3.1.1 Acetylene forms readily under certain conditions, explosive acetylides with copper, silver and mercury. These acetylides can detonate under shock and friction. In normal service conditions involving contact with highly caustic salts or solutions or contact with other materials corrosive to copper or copper alloys can render the generally acceptable alloys unserviceable for this service. The presence of moisture, certain acids, or alkaline materials tends to enhance the formation of copper acetylides.

4.3.1.2 In the liquid or solid state or in the gaseous state at moderate or high pressure acetylene can be decomposed rapidly with the formation of carbon and hydrogen and evolution of heat. The decomposition of acetylene can be initiated by heat. Decomposition of liquid or solid acetylene also can be initiated by mechanical impact. In a confined space, the heated decomposition gases can cause detonation and consequent equipment and piping failure.

4.3.2 Auto Ignition Temperature 305°C

4.3.3 Light Sensitivity No

4.3.4 Flammability

Explosive limits, with air, $\left\{ \begin{array}{l} \text{LEL} \text{ — } 2.5 \\ \text{UEL} \text{ — } 82 \end{array} \right.$
percent(v/v)

If an ignition source is present 100 percent acetylene will decompose with violence under certain conditions of pressure and container size and shape.

4.3.5 Flash Point (-)17.7°C (closed cup)

4.4 Fire and Explosive Properties

4.4.1 Acetylene presents combustion, explosion and fire hazards when released from containment. Because of its reactivity it is easier to ignite than most flammable gases and burns more rapidly. The latter effect increases the severity of combustion explosion and increases the difficulty of providing explosion venting. Government of India notification No. GSR 625(E) dated 7-8-83 which declares that acetylene when liquid or when subject to any pressure or when in ad-mixture with air and oxygen in whatever proportion and whatever pressure and whether or not in admixture with other substances shall be deemed as explosive within the meaning of the said Act.

5 HEALTH EFFECTS AND TOXICITY INFORMATION

5.1 Route of Entry

Inhalation

5.2 Exposure Concentration, Duration and Health Effects

5.2.1 General

Acetylene is a simple asphyxiant and anesthetic. Inhalation of 10 percent acetylene has a slight intoxicating effect in man. Marked intoxication occurs at 20 percent, loss of coordination at 30 percent, unconsciousness in 7 minutes exposure at 33 percent and unconsciousness upon 5 minutes exposure at 35 percent. Complete anesthesia, increased blood/ pressure, narcosis and stimulated respiration at 80 percent. No evidence exists that repeated exposure of tolerable levels of acetylene has deleterious effects on health. The maximum permissible limit for acetylene in any working environment should not exceed 0.5 percent (5 000 ppm). Pure acetylene is non toxic at the beginning and if acetylene contains 0.05 percent phosphine as impurity its maximum permissible concentration shall be 500 ppm. TLV (NIOSH/OSHA) is 2 500 ppm.

5.2.2 Eyes

Not much effect of irritation and burning sensation of the eyelids.

5.2.3 Ingestion

Route of entry being inhalation there is no effect on the digestive tract.

5.2.4 Skin Contact

It does not get absorbed through skin.

6 PERSONAL PROTECTIVE EQUIPMENT

6.1 Personal protective equipment should include safety goggles while examining the porous mass of the cylinder and leather hand gloves in case cylinders are handled manually. Self-contained breathing apparatus shall be used in areas of high concentration.

7 STORAGE, HANDLING, LABELLING AND TRANSPORTATION

7.1 Storage

Acetylene is dissolved in acetone. Acetylene in its free state under pressure may decompose violently. The higher the pressure, the smaller the initial force required to cause an explosion. Therefore, use of gas in free state outside the cylinder is normally permissible at pressure of 9 Psig. Under special circumstances and adequate safety measures and after obtaining clearance from the statutory authority (Chief Controller of Explosives) acetylene gas in free state may be used at pressure of maximum 15 Psig.

Pressure exceeding this limit are utilized for chemical synthesis, however, special means to ensure safety are employed.

7.1.1 Acetylene cylinders are filled with a porous material which holds the acetone. Dissolved acetylene cylinder means a portable vessel of approved design, having a valve, with or without safety devices, containing porous mass and acetone or other solvent for the storage of dissolved acetylene and the quantity of acetylene saturating the solvent at atmospheric pressure and at a temperature of 15°C. Acetylene cylinders avoid the decomposition characteristics of the gas by providing a porous mass packing material having minute cellular spaces so that no pockets of appreciable size remain where free acetylene in gaseous form can collect. The maximum working pressure of the cylinder charged with acetylene at 15°C is equal to 16 kgf/cm² when acetone is the solvent.

7.2 Handling

7.2.1 Acetylene cylinders should be used or stored only in an upright position to avoid possibility of acetone leaking from cylinder. However, where this is not possible it is recommended that the cylinder be put in an upright position and left that way for about half an hour before being used. Acetylene cylinders should be handled very carefully to prevent damage which might lead to bursting of cylinders or leakage through the cylinder valve. They should not be banged, jolted, violently dropped or thrown about when being unloaded from a truck. The cylinder should be lowered gently. A suitable carrying device for acetylene cylinders should be used.

Use only standard keys for operating the valves and make sure that these are free from oil and grease.

7.2.2 When using acetylene, cylinder valve should be closed before shutting of the regulator to permit the gas to bleed from the regulator.

Acetylene should not be used through blowpipes or other devices equipped with shut-off valves on the acetylene supply connections without reducing the pressure through a suitable regulator.

7.2.3 Storage of acetylene and oxygen cylinders together is not permitted. They should be separately grouped.

Before using acetylene ensure that all connections are gas tight and remain so. Always open cylinder valve slowly. Never use a hammer or mallet in attempting to open or close a valve. Do not open in acetylene cylinder valve more than one and one-half turns.

7.2.4 Acetylene is highly flammable. Acetylene cylinders should not be stored near an open flame, nor where, in case of a leak, the gas can diffuse to a flame or spark from a motor. In premises for filling and storing acetylene gas in cylinders all electric meters, distribution boards, switches, fuses, plugs and sockets, electric fixed lamps, portable hand lamps shall be of flame proof construction conforming to IS 2148.

The wrench used for opening the cylinder valve should always be kept on the valve spindle when the cylinder is in use.

Any hand tools employed should be of the non-sparking type. Containers, pipes, valves or fittings made of copper or copper alloys (brass, bronze) should not be used.

In installation for the manufacture or use of acetylene, safety devices must be provided to reduce pressure and flash backs and to prevent the formation of explosive mixture.

7.2.5 When using acetylene, good ventilation should always be provided to remove any explosive mixture as rapidly as possible.

The colour of the acetylene gas cylinder shall be as prescribed in IS 4379.

7.2.6 When returning empty acetylene cylinder, ensure closing of the valves.

7.2.7 There are rigid regulations covering the filling of acetylene cylinders and since this process may be hazardous, if improperly done, acetylene cylinders must be filled only by experienced and trained and authorised persons and strictly in accordance with Rules 45-50 of *Gas Cylinder Rules*, 1981.

7.2.8 When installing acetylene cylinders, the user should comply with all local, state and municipal regulations.

7.2.9 Safety devices in valves or cylinder should never be tampered with.

7.2.10 No attempt should be made under any circumstances to transfer acetylene gas from one cylinder to another to refill acetylene cylinder, or to mix any other gas with acetylene in a cylinder.

7.2.11 Acetylene cylinders should not be used as rollers or supports or for any other purpose other than storing acetylene.

7.3 Labelling

7.3.1 Use of hazard warning labels/symbols in plant area are recommended.

7.3.2 Cautionary and warning notice should be displayed.

SMOKING STRICTLY PROHIBITED

NO NAKED FLAME

AVOID LEAKAGES

7.3.3 Information on Labels

- a) Every cylinder shall be labelled with the name of gas and name and address of person by whom the cylinder was filled.
- b) Date of last filling of gas in the cylinder.
- c) Weight of gas filled.
- d) A warning in the following terms shall be attached to every cylinder:
 - i) Do not change the colour and marking of the cylinder.
 - ii) This cylinder should not be filled with any gas other than the one it contains.
 - iii) No flammable material should be stored in the immediate vicinity of this cylinder or in the same room where it is kept.
 - iv) No oil or similar lubricant should be used on the valves and other fittings of this cylinder.
 - v) Look for the next date of test, which is marked on a metal ring inserted between the valve and the neck of the cylinder, and if the date is over do not accept the cylinder.
 - vi) Do not accept the cylinder without a valve.

7.4 Transportation

7.4.1 Cylinders must be protected against dropping when being unloaded from a truck or platform. Don't drag or roll the cylinder.

7.4.2 Transportation of cylinders in a two wheeled mechanically propelled vehicle is prohibited.

7.4.3 Cylinders should be so transported as not to project in the horizontal plane beyond the sides or ends of the vehicle.

7.4.4 There shall be no sharp projections on the inside of the vehicle.

7.4.5 Cylinders should be adequately secured to prevent their falling from the vehicle and being subjected to rough handling, excessive shocks or local stresses.

7.4.6 Cylinders transported in vehicles shall be blocked or braced and be so secured to prevent movement, striking each other or falling down.

7.4.7 Cylinders should not be transported alongwith any other articles of flammable or corrosive nature

and also alongwith the cylinders containing any other type of compressed gases especially oxygen.

7.4.8 Lifting magnet, ropes or chain or any other device in which the cylinder itself forms a parts of the carrier, should not be used for hoisting acetylene cylinders. When it is to be hoisted, a platform cage or cradle should be provided to protect the cylinder from being damaged and to keep it from falling out.

7.4.9 Every acetylene cylinder shall when transported have it's valve protected against damage.

7.5 Storage, transportation and handling of acetylene in cylinder shall confirm to *Gas Cylinder Rules*, 1981.

8 SPILLAGE/LEAKAGES AND WASTE DISPOSAL

8.1 Spillage/Leakage

8.1.1 Because acetylene and air in certain proportions are explosive, care should be taken to prevent acetylene leakage, connections should be kept tight and hose maintained in good condition.

8.1.2 Points of suspected leakage should be tested with soap solution. Never test the leak with open flame.

8.1.3 If acetylene leaks around the valve spindle when the valve is open, close the valve and tighten gland nut. If this does not stop leak the supplier should be notified.

8.2 Waste Disposal

8.2.1 In case there is leak through the safety fusible plug, the cylinder should be removed in an open space well away from any possible source of ignition. Open the valve slightly to let the acetylene escape slowly. A sign to be placed near the cylinders warning persons approaching the cylinder with cigarettes or with any other open lights. When the cylinder is empty, close the valve and notify the manufacturer.

8.2.2 Acetylene cylinder developing a leak during transport shall be promptly removed to an open isolated place away from any source of ignition and the person responsible for transportation shall immediately contact the filler or the consignor for necessary advice.

9 FIRE PREVENTION AND FIRE FIGHTING

9.1 Fire Prevention

9.1.1 No persons shall smoke and no articles or substances of flammable nature or liable to spontaneous ignition or communicate fire or explosion shall be allowed at any time in proximity to a place where any cylinder for acetylene gas is being filled, stored or handled.

9.1.2 No person in or near any place where acetylene is filled stored or handled shall have in possession any matches, fuses or other appliances for producing ignition or explosion.

9.1.3 In premises for filling and storing acetylene gas into cylinders, all electrical meters, distribution boards, switch fuses, plugs and sockets, electric fixed lamps, portable hand lamps and motors shall be of flame proof construction conforming to IS 2148.

9.2 Types of Extinguishers to be Used

Carbon dioxide can be used to extinguish the flame. Water spray may be used to keep fire exposed cylinders cool. Water spray or soda acid/pressured water - CO₂ type extinguishers must not be used in case of fire in the calcium carbide godown or generator hopper for producing acetylene.

10 TRAINING AND HEALTH MONITORING

10.1 Training and Education

Persons handling or working in plant involving acetylene shall have training so that they can expected to carry out their jobs safely and effectively. They should be familiar with accepted methods of handling and hazards involved in producing, storing, handling and using of acetylene gas. During instructions stress

should be given to particularly hazardous nature of the gas. All persons should be familiar with the location of fire alarm boxes, first aid boxes and fire extinguishers.

10.1.1 Safety in handling acetylene depends to a great extent upon the effectiveness of employees education, proper safety instructions, intelligent supervision and strictly complying with safety rules and regulation.

10.2 Health Monitoring

10.2.1 Pre-Employment Medical Examination

Other than normal and routine pre-employment medical examination, there need not be any specific stipulation.

11 FIRST AID

11.1 Exposure to high concentration of acetylene causes intoxication and loss of coordination. Workmen with these symptoms should be removed at once to uncontaminated air and a physician should be called. If breathing stops, given artificial respiration immediately and call for medical attention. If breathing is difficult, administer oxygen quickly. In all cases call for a doctor immediately.

ANNEX A
(Foreword)

COMMITTEE COMPOSITION

Chemical Hazards Sectional Committee CHD 7

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Explosive/Flammable Substances Subcommittee, CHD 7:2

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Review of Indian Standards

Amendments are issued to standards as the need arises on the basis of comments. Standards are also reviewed periodically; a standard along with amendments is reaffirmed when such review indicates that no changes are needed; if the review indicates that changes are needed, it is taken up for revision. Users of Indian Standards should ascertain that they are in possession of the latest amendments or edition by referring to the latest issue of 'BIS Catalogue' and 'Standards: Monthly Additions'.

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Amendments Issued Since Publication

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